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Impact of a Health Promotion Program on Knowledge, Physical Health, Mental Health, and Social Health Behaviors in Individuals at Risk for Colorectal Cancer

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Abstract: Colorectal cancer (CRC) is a significant public health issue, particularly in low- and middle-income countries like Thailand. While numerous studies advocate for regular screenings and health promotion programs to mitigate CRC risk, there is a notable lack of tailored health promotion models specifically designed for high-risk groups in Thailand. This research aims to develop a health promotion model to prevent CRC in high-risk groups through a quasi-experimental design. The study involved 68 Thai participants aged 40–70 years, divided equally into experimental and comparison groups. Independent-Samples *t*-test, Paired-Samples *t*-test, and one-way variance test (F-test) were employed to analyze the data. The comparison of baseline average scores for physical health, mental health, social health, and knowledge on health-promoting behaviors between the experimental and comparison groups revealed no significant differences. However, following the experiment, the average scores in physical health ($t = -2.81$, $p = 0.01$) and mental health ($t = -10.30$, $p < 0.001$) were significantly higher compared to pre-experiment levels, with the exception of social health ($t = 0.07$, $p = 0.94$). Furthermore, the average knowledge scores related to promoting physical, mental, and social health in the experimental group also showed a significant increase after the experiment ($t = -4.53$, $p < 0.001$). The findings suggest that health personnel should advocate for annual CRC screening and the implementation of health promotion programs, especially focusing on physical, mental, and social aspects for at-risk populations. This study underscores the need for long-term health promotion models to achieve continuous and sustainable health improvements in these groups.

Keywords: health-promoting behaviors; health promotion; colorectal cancer; primary prevention; physical health; mental health; social health

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1. Introduction

Cancer is a chronic disease that poses a global public health problem, being the leading cause of death worldwide with an increasing trend each year. The World Health Organization (WHO) found that in 2018, there were 18.1 million new cancer cases and 9.6 million cancer-related deaths [1]. The top-five common cancers globally are lung cancer, breast cancer, colorectal cancer, prostate cancer, and stomach cancer [2]. Among the 18.1 million new patients, 18.1 million were diagnosed with colorectal cancer, and out of the 9.6 million deaths, 881,000 were due to colorectal cancer [1].

Colorectal cancer (CRC) is also a significant public health concern in Thailand, ranking among the top-five most common cancers in the country [2]. According to the Global Cancer Observatory, an initiative of the WHO, Thailand recorded an estimated 17,931 new cases of CRC in 2020, making it the third-most common cancer in the country [2]. The mortality rate is also alarmingly high, with approximately 10,235 deaths attributed to CRC in the same year [2]. Males and females were equally likely to suffer from CRC, ranking

as the second-most common cancer for both genders [3]. The risk of developing CRC increases significantly with age. In Thailand, as in many other countries, the majority of CRC cases are diagnosed in individuals aged 50 years and older [4]. By focusing on the 40–70 age group, this study aims to target a population that is entering or already within the high-risk age bracket, where preventive measures and early detection can be most effective in reducing mortality and morbidity [5]. This age group is often still active in the workforce and socially engaged, making them more likely to benefit from health promotion programs that encourage lifestyle changes such as increased physical activity, healthier eating habits, and regular screenings. Consequently, cancer remains a significant health problem that has garnered widespread attention as one of the leading causes of death in many developing and underdeveloped countries, including Thailand. These figures underscore the growing burden of CRC on the Thai healthcare system and highlight the need for effective prevention and early detection strategies [6].

In Thailand, CRC is a significant public health concern, with varying incidence and mortality rates in different regions. Despite national efforts to promote regular screenings and healthy lifestyles, there is a notable lack of tailored health promotion programs addressing the specific needs of Thai communities. Especially in rural areas such as Kanchanaburi province, challenges like limited healthcare access, socioeconomic disparities, and cultural beliefs contribute to lower participation rates in CRC prevention activities. This study aims to bridge these gaps by developing and evaluating a culturally adapted health promotion model for high-risk groups in Thailand.

2. Literature Review

The health behaviors of the population are changing rapidly in many aspects due to expansion in the economy, environment, technology, and industry. This is particularly evident in the area of food, where many types of additives are used to enhance taste and appeal to consumers. As a result, inappropriate health behaviors, such as lack of exercise and stress-related behaviors, have become more common. These behaviors are likely to contribute to future health problems, including non-communicable diseases affecting both physical and mental health. Diseases caused by genetics, environmental factors, and pollution are also on the rise.

WHO promulgated the Ottawa Charter during the inaugural global conference in 1986, thereby instituting comprehensive policies aimed at promoting health and preventing disease [7]. These measures emphasized the importance of healthy dietary practices, regular physical activity, and smoking cessation [7]. Although the precise etiology of CRC remains elusive, a number of risk factors have been elucidated. These include the consumption of red meat (such as beef, pork, and lamb), diets high in animal fat, a sedentary lifestyle, obesity, diabetes, smoking, alcohol consumption, and a history of chronic ulcerative colitis [8–10]. Consequently, it is imperative that individuals presenting these risk factors seek medical consultation for CRC screening. The fecal occult blood test serves as an initial diagnostic tool for the early detection of CRC [11].

In 2019, Kanchanaburi Province in western Thailand initiated a colon and intestinal cancer screening project. The screening identified abnormalities in 9.45% of participants, of whom 5.58% underwent colonoscopy, revealing abnormalities in 35.08% and cancer in 4.42% of cases. In 2020, 9.07% of participants were screened, with abnormalities found in 4.69%, and 35.08% of those who underwent colonoscopy had abnormalities, with 4.09% diagnosed with cancer. By 2021, 7.83% were screened, 4.66% exhibited abnormalities, and colonoscopy revealed abnormalities in 16.50% of cases, with a cancer diagnosis rate of 3.03% [6]. The persistent high incidence of CRC in Thailand underscores significant healthcare challenges attributable to several factors [12]: (1) the absence of comprehensive population-based CRC screening programs, which are also challenging to implement; (2) quality control issues within the national CRC registry; (3) limited financial resources and a shortage of highly skilled healthcare providers for both curative and palliative care of CRC patients; and (4) advanced treatment options, such as minimally invasive surgery,

chemotherapy, and radiation, which are predominantly available only at referral university hospitals or specialized cancer institutes. Consequently, the implementation of preventive measures for CRC can be one of the most cost-effective strategies for resource-limited countries like Thailand.

Physical health behavior includes the actions individuals take to maintain or improve their physical well-being [13]. This involves engaging in regular physical activity, maintaining a balanced diet, avoiding harmful substances, and participating in preventive health screenings. These behaviors are crucial for preventing a range of chronic diseases, such as colorectal cancer, cardiovascular diseases, diabetes, and obesity [14]. Several systematic reviews with meta-analyses have summarized evidence for the associations between physical health behavior in dietary factors (e.g., foods, beverages, and alcohol), and the incidence of CRC [15–17]. Regular participation in preventive screenings, such as colonoscopies, is a critical aspect of maintaining physical health [18]. Early detection through screenings is essential for identifying precancerous lesions and early-stage cancers, thus significantly improving treatment outcomes [19].

Mental health behavior plays a crucial role in shaping health behaviors, particularly in the prevention of chronic diseases. Mental health behavior encompasses the actions and practices individuals undertake to support or enhance their psychological well-being [20]. This includes managing stress, seeking social support, practicing mindfulness or relaxation techniques, and following treatment plans for mental health issues [21]. Such behaviors are vital for overall health because they affect not only mental well-being but also physical health outcomes and the capacity to adopt and sustain healthy lifestyle habits [20]. Research shows that individuals with better mental health are more likely to participate in preventive behaviors, such as regular health screenings and adopting a healthy lifestyle [22,23].

Social health—defined by the quality of relationships and the strength of social support networks—is increasingly recognized as a key factor in promoting health behavior change and preventing disease [24]. Strong social connections, whether from family, friends, or community members, significantly influence an individual's willingness to engage in health-promoting activities, including routine screenings and healthier living choices [25]. Additionally, robust social networks provide essential emotional support, practical help, and encouragement, all of which are critical for sustaining long-term behavior change [26].

A comprehensive review of both the domestic and international literature reveals numerous studies examining the effects of providing knowledge on behavior among individuals at risk for CRC. For instance, a prior study examined the effects of providing knowledge on behavior prior to colonoscopy in individuals at risk for CRC [27], while one study investigated the impact of a preparatory information and counseling program on the readiness and anxiety of patients undergoing colonoscopy and rectal endoscopy [28]. Another study focused on the effects of risk counseling for first-degree relatives of individuals with CRC [29]. Additionally, research has been conducted on the impact of colonoscopy screening on the risks of CRC and related mortality [30]. However, there appears to be a paucity of research on health promotion programs specifically targeting populations at risk for CRC. It is imperative that these at-risk groups are educated about and made aware of the health behaviors that contribute to their risk of CRC. Key risk factors include the consumption of pork, beef, and high-fat foods, alcohol intake, smoking, lack of exercise, and having a BMI above the standard. Furthermore, the regular consumption of charred and smoked foods has been associated with the development of CRC [31]. Addressing these factors through targeted health promotion initiatives could significantly reduce the incidence of CRC in these populations.

From the statistical data and literature review of both domestic and international sources, it is evident that CRC screening is infrequent in certain regions, and there is a continual rise in the number of CRC patients. Additionally, existing health promotion programs face significant limitations within these contexts.

3. Theoretical Framework

The Health Belief Model (HBM) serves as a suitable theoretical framework for this study due to its focus on individual beliefs as determinants of health behavior [32]. In this research, the HBM guides the development of a health promotion program aimed at improving knowledge and influencing behaviors related to colorectal cancer prevention among high-risk groups in Thailand. Consequently, this study is grounded in the HBM, a well-established theoretical framework that has been extensively used to study health behaviors [32]. The HBM suggests that individuals' beliefs about health problems, perceived benefits of action, and barriers to action can predict health-related behaviors. The program includes educational components that increase awareness of CRC risk and the potential consequences of not engaging in preventive behaviors. By highlighting the prevalence and impact of CRC, the intervention aims to enhance participants' perceived susceptibility and perceived severity. The intervention addresses perceived benefits by educating participants about the advantages of regular screenings, healthy diets, and physical activity in reducing cancer risk. Simultaneously, it tackles perceived barriers by providing practical solutions and resources, such as information on low-cost screening options and community support for behavior change. The program incorporates reminders and motivational cues, such as text message reminders for screenings and health education sessions led by healthcare providers, to prompt participants to take preventive actions. To build self-efficacy, the program includes skill-building activities that empower participants to adopt and maintain healthy behaviors, such as cooking classes for healthy meals and guided exercise sessions. This model is particularly relevant for understanding how high-risk populations perceive the threat of CRC and the potential benefits of preventive measures. Incorporating the dimension of social health within the HBM framework allows us to explore how social factors, such as family and community support, influence health behaviors. Previous studies have shown that social support can mitigate perceived barriers to action and enhance self-efficacy, making individuals more likely to adopt and sustain healthy behaviors [26]. This model aims to increase awareness of disease risk, severity, benefits, and barriers, ultimately fostering improved health behaviors. The development of this model involves integrating components that promote comprehensive physical, mental, and social health. These components include the formulation of health promotion policies, creating supportive environments, enhancing personal skill development, highlighting the perceived benefits of healthy practices, and fostering a commitment to healthy behavior development. Moreover, the model emphasizes the provision of family health services and the implementation of health promotion activities. The study also involves the creation of eight learning management plans: (1) behavior modification activities, (2) health creation activities, (3) disease surveillance activities, (4) disease literacy campaigns, (5) happiness exchange activities, and (6) recommendations for promoting good health among at-risk Thai populations. Our study seeks to fill this gap by using the HBM to design and evaluate a targeted health promotion intervention that includes components of social health. Thus, the primary objective is to develop a health promotion model to prevent CRC among at-risk groups, providing foundational information to support primary health promotion. This encompasses physical, mental, and social health, aiming to maintain the overall well-being of individuals and reduce the incidence of CRC.

4. Materials and Methods

4.1. Research Design, Setting, and Participants

This research is a quasi-experimental study involving two groups: an experimental group and a comparison group, with measurements taken before and after the intervention. The population comprised 16,917 individuals, aged 40–70 years, registered in the civil records of Kanchanaburi Public Health Office [6]. The sample size was determined using the Krejcie and Morgan formula [33], resulting in an initial sample size of 36 participants for both the experimental and comparison groups. To account for potential sample attrition, the researchers doubled the sample size, resulting in 72 participants per group. During

the course of the experiment, there were two dropouts from both the experimental and control groups. Consequently, the final sample consisted of 34 participants in the experimental group and 34 participants in the comparison group, totaling 68 participants across both groups.

The sample selection process employed a multi-stage sampling method. The target population for the study was individuals aged 40–70 years residing in Kanchanaburi province, Thailand. The total population was divided based on administrative regions or clusters, such as districts or sub-districts. The first stage involved selecting a subset of clusters from six sub-districts from the overall population. This was performed using random sampling methods, ensuring that the selected clusters were representative of the larger population. In the second stage, within each selected cluster, a further division was made into smaller units into communities. Again, random sampling was employed to select specific communities from these smaller units. For the final stage, from the chosen communities, individual households were randomly selected. The selection of participants was conducted by randomly choosing one eligible individual (aged 40–70 years) from each household (Figure 1). Participants were selected by choosing one individual from each household based on specific criteria: (1) age between 40 and 70 years, both male and female, (2) ability to understand, read, and write Thai, and (3) willingness to participate in the project. In households with more than one eligible participant. The exclusion criteria included individuals with chronic illnesses that hinder participation in the program and those unable to commit to the 8-week duration of the study. Participants meeting these criteria were excluded from the current study.

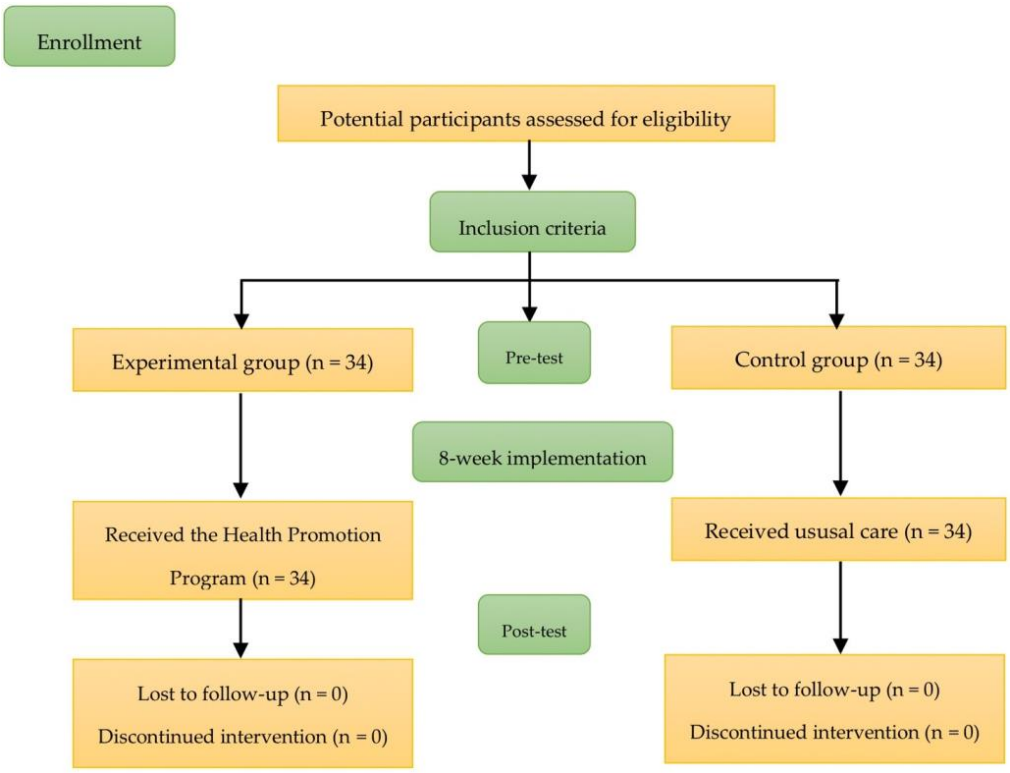

Figure 1. The flow of participants throughout the study.

4.2. Study Area

Kanchanaburi province, located in western Thailand, is characterized by its diverse socioeconomic landscape. The economy primarily relies on agriculture, small-scale industry, and tourism, with a significant proportion of the population engaged in farming and local trade. The province has a mix of urban and rural communities, with varying access to healthcare facilities. Public health challenges in Kanchanaburi include limited

access to specialized care, lower screening rates for colorectal cancer, and cultural barriers to preventive health practices. This setting provides a unique context for studying the effectiveness of a tailored health promotion intervention aimed at high-risk groups.

4.3. Research Instruments

The research instruments used to collect data consist of five parts as follows:

Physical Health Behavior Scale (PHBS): This scale, developed by the researchers based on a review of the relevant literature and theoretical concepts [32], comprises 23 items. It employs a four-point rating scale: 4 = completely practicable, 3 = mostly practicable, 2 = slightly practicable, and 1 = unable to perform. The average score is categorized into three levels of self-efficacy in physical health behavior using Best and Kahn [34] class interval criteria: low (23–46), medium (47–69), and high (70–92). This tool was examined by five qualified experts who tested for content validity index (CVI) and reliability. The validity of the PHBS was 0.74 and the reliability of this instrument was tried out with 30 samples by finding the Cronbach's alpha coefficient (α–coefficient), which equaled 0.83.

Mental Health Behavior Scale (MHBS): Also developed from the literature review and theoretical concepts [32], this scale includes 15 items. It uses a similar four-point rating scale: fully practicable, mostly practicable, slightly practicable, and unable to perform. The scores are divided into three levels based on Best and Kahn [34] criteria: low (15–30), medium (31–45), and high (46–60). This tool was evaluated by five qualified experts who assessed its CVI and reliability. The validity of the MHBS was determined to be 0.76, and its reliability was tested with a sample of 30 participants, yielding a Cronbach's alpha coefficient (α) of 0.80.

Social Health Behavior Scale (SHBS): This scale contains 12 items, developed from the literature and theoretical concepts [32], and uses a four-point rating scale identical to the previous scales. The scoring criteria, as per Best and Kahn [34] class interval, categorize scores into low (12–24), medium (25–36), and high (37–48). This tool was evaluated by five qualified experts who assessed its CVI and reliability. The validity of the Physical Health Behavior Scale (PHBS) was determined to be 0.79, and its reliability was tested with a sample of 30 participants, yielding a Cronbach's alpha coefficient (α) of 0.81.

Knowledge on Promoting Physical, Mental, and Social Health Scale: This section, also developed from the literature review and theoretical concepts [32], includes 18 multiple-choice questions. Each correct answer is awarded 1 point, while incorrect or unanswered questions receive 0 points. The scores are categorized using Best and Kahn [34] class interval criteria: low (0–6), medium (7–12), and high (13–18). Five qualified experts evaluated this tool for its CVI and reliability. The validity of this tool was measured at 0.72, and its reliability, tested on a sample of 30 participants, resulted in a Cronbach's alpha coefficient (α) of 0.84.

Sociodemographic Data: This section includes variables such as gender, age, education, marital status, occupation, income, adequacy of income, congenital diseases, smoking history, number of residents in the family, exercise behaviors, weight, height, and family history of CRC. The questions are both multiple-choice and open-ended.

4.4. Procedure

After securing ethics approval from the research committees, the research team convened to outline the scope of the study and determine the tools to be used. The researchers worked with the Subdistrict Health Promoting Hospital to obtain permission for data collection, clearly explaining the research objectives and procedures. The intervention focused on evaluating the outcomes of a health promotion program for individuals at risk of CRC. Researchers detailed the participation process to the participants and obtained their signed consent before implementing the health promotion model in the intervention group. Conducted between September and December 2022, the program lasted eight weeks, each week lasting 50 min and included the following activities:

Intervention Group:

Week 1: Organized the first learning activity, "Behavior Change Activities". During this week, the focus was on analyzing and planning health behavior modification activities, creating tailored health behavior modification activities for the intervention group, and practicing these skills with the participants.

Activity: The session involved collaborative planning where participants, guided by the program facilitators, worked together to create personalized behavior modification plans. These plans were designed to address specific health challenges faced by each participant, such as dietary habits, physical inactivity, or stress management. The plans were not only evidence-based but also customized to fit the unique needs and circumstances of each participant.

Purpose: This activity served as a critical starting point for the health promotion program, ensuring that participants were prepared and motivated to embark on their journey towards healthier behaviors. This initial week was designed to empower participants with the knowledge, skills, and confidence necessary to successfully modify their health behaviors and sustain these changes over time.

Week 2: Conducted the second learning activity, "Health Promotion Activities". Researchers explained the importance of personal skills related to food consumption, exercise, stress relief, and relaxation. They also highlighted the severity of health risks associated with incorrect behaviors. Participants were trained in health-building activities.

Activity: Participants were trained in specific health-building activities. This practical training included demonstrations and hands-on exercises that allowed participants to practice what they had learned. For example, they might have participated in guided exercises, learned techniques for preparing healthy meals, or practiced mindfulness and relaxation exercises.

Purpose: This activity served as a key component of the program, providing participants with the tools and motivation needed to make lasting improvements in their health. By focusing on both education and practical application, this activity aimed to empower participants to take control of their health and prevent the onset of chronic diseases, including CRC.

Week 3: Implemented the third learning activity, "Disease Surveillance Activities". This activity emphasized the benefits of health promotion practices, selecting methods for using personal skills for disease prevention, and practicing disease surveillance activities.

Activity: The session began with researchers and facilitators providing detailed explanations of how these behaviors directly impact overall health and well-being. Participants learned about the importance of balanced nutrition, regular physical activity, and effective stress management techniques. The facilitators highlighted the long-term health risks associated with unhealthy behaviors, such as poor diet, sedentary lifestyle, and unmanaged stress, which can contribute to chronic diseases like CRC.

Purpose: Educate and equip participants with the knowledge and skills necessary for proactive disease prevention and early detection.

Week 4: Carried out the fourth learning activity, "Disease Literacy Campaign". This activity focused on identifying health promotion activities to prevent disease, highlighting the benefits of physical health behaviors, and training participants in disease literacy campaigns. Participants were also trained in developing good mental and social health.

Activity: Participants were introduced to the concept of disease literacy, which involves having the knowledge, skills, and confidence to understand and use information to make informed health decisions. They engaged in hands-on activities to design and participate in disease literacy campaigns, where they learned how to communicate important health messages effectively within their communities. Additionally, the activity included training on the interconnection between physical, mental, and social health, emphasizing the importance of a holistic approach to disease prevention.

Purpose: Educate participants about the benefits of healthy behaviors and to empower them to lead and influence disease prevention efforts in their communities, ultimately contributing to the reduction in CRC incidence.

Weeks 5–6: Conducted the fifth learning activity, "Happiness Exchange Activity". This activity focused on identifying family health services, understanding the benefits and barriers to practicing good health behaviors, and explaining the advantages of overcoming these barriers. It also included training in activities aimed at exchanging happiness within the family.

Activity: Participants were guided through the process of recognizing both the benefits and barriers to practicing healthy behaviors. They engaged in group discussions and interactive exercises to identify common challenges. Additionally, the activity emphasized the importance of fostering positive emotions and relationships within the family by incorporating activities that promote happiness, such as shared meals, physical activities, and open communication. Training sessions were conducted to equip participants with practical skills for enhancing family well-being, focusing on activities that promote joy, reduce stress, and strengthen familial bonds. These sessions also encouraged participants to exchange ideas and experiences about how happiness and well-being can be cultivated within their family environments.

Purpose: Integrate health promotion with family dynamics, highlighting the crucial role of family support in achieving long-term health goals. By addressing both the emotional and practical aspects of health within the family, this activity aimed to create a more holistic approach to disease prevention and well-being.

Weeks 7–8: Conducted the seventh learning activity, "Activities to Introduce Good Health". In this final activity, participants discussed activities promoting physical, mental, and social health. They explained the importance of integrating good health activities into learning, fostering motivation, and enhancing self-esteem regarding behavior change. The session included physical health and activity skills training to recommend good health practices.

Activity: Throughout the sessions, participants were encouraged to share their experiences and insights about incorporating health-promoting activities into their daily routines. They discussed the significance of making these activities an integral part of their lives, highlighting how consistent practice can lead to long-term health benefits. The activity also emphasized the role of education in fostering motivation and enhancing self-esteem, particularly in relation to behavior change. In addition to discussions, the sessions included hands-on training in physical health and activity skills. Participants learned specific exercises and health practices that they could implement at home to maintain and improve their physical health. The training was designed to be practical and adaptable, ensuring that participants could easily integrate these practices into their daily lives.

Purpose: This activity served as a key component of the health promotion program, ensuring that participants were not only educated about health-promoting behaviors but also equipped with the skills and motivation needed to sustain these behaviors in the long term. This final activity was designed to help participants leave the program with a clear understanding of how to maintain and enhance their health moving forward.

Mode of Delivery:

The program was delivered through a combination of in-person workshops, group activities, and individual counseling sessions. Educational materials, including brochures, handouts, and visual aids, were provided to support the learning process. Instructors with expertise in health promotion and behavior change facilitated the sessions, ensuring that the content was accessible and engaging for participants.

In-Person Workshops: these were held weekly, where participants gathered for interactive sessions that included presentations, discussions, and practical exercises.

Group Activities: group activities encouraged peer support and learning, with participants engaging in exercises, role-plays, and discussions to reinforce the concepts taught.

Individual Counseling: participants received one-on-one counseling to address specific concerns and tailor the health promotion strategies to their individual needs.

Follow-Up and Support: throughout the 8-week program, participants were provided with ongoing support through regular follow-up meetings and phone calls to encourage adherence to the recommended behaviors.

Comparison Group: The comparison group received standard advice from their health officer on proper nutrition and the importance of exercise for maintaining health. Upon completing the 8-week activities, the comparison group participated in a health promotion program aimed at preventing CRC.

4.5. Data Analysis

This research analyzed the data using the Statistical Package for Social Sciences (SPSS) version 25.0 software. General data analysis employed descriptive statistics, including mean, percentage, and standard deviation. The distribution of data was tested for normality by using the Kolmogorov–Smirnov test. *t*-tests were selected because they were well suited for comparing the means of two groups. In this study, Independent-Samples *t*-tests were used to compare the physical, mental, and social health behavior scores between the experimental and comparison groups, while Paired-Samples *t*-tests were employed to compare pre- and post-intervention scores within each group. This allows us to assess the effectiveness of the health promotion intervention by determining whether there were significant changes in scores. One-way variance test (F-test) was chosen to analyze differences in scores across multiple groups or conditions, ensuring that the variations observed are not due to random chance. F-test was used to compare the variance in scores among different demographic subgroups or across multiple time points, providing a more comprehensive understanding of the factors influencing physical, mental, and social health behavior changes. Additionally, Fisher's Least-Significant Difference (LSD) method was applied to test for differences in means between pairs. A p-value < 0.05 was considered statistically significant.

5. Results

In this study, the intervention and comparison group samples showed that the majority of participants were female (73.53%), with an average age of 52.26 years (S.D. = 6.04). Most participants had completed elementary school or lower (55.88%) and were married (76.47%). A significant portion of the participants (57.35%) worked in agriculture, and 94.12% had an income of less than $8915 USD. Additionally, 58.88% reported having an income less than their expenses, 32.35% had a congenital disease, 19.12% currently smoked, and 25.00% consumed alcohol. Furthermore, 66.18% had no more than four family members, 20.59% exercised 3–5 days per week, and 13.24% had a history of illness (Table 1).

Table 1. Sociodemographic characteristics of the participants.

Demographic Characteristics	Intervention Group		Comparison Group		Total	
	n	%	*n*	%	*n*	%
Sex						
Female	32	94.12	18	52.94	50	73.53
Age (years)	Mean ± SD = 52.44 ± 5.66		Mean ± SD = 52.09 ± 6.48		Mean ± SD = 52.26 ± 6.04	
<50	17	50.00	22	64.71	39	57.3
>50	17	50.00	12	35.29	29	42.65
Marital status						
Single	2	5.88	4	11.76	6	8.82
Married	29	85.29	23	67.65	52	76.47
Divorced/Widowed	3	8.82	7	20.59	10	14.71

Table 1. *Cont.*

Demographic Characteristics	Intervention Group		Comparison Group		Total	
	n	%	*n*	%	*n*	%
Education level						
Elementary school or lower	20	58.82	18	52.94	38	55.88
Primary school	6	17.65	7	20.59	13	19.12
High school or higher	8	23.53	9	26.47	17	25.00
Current Occupation						
Agriculturist	23	67.65	16	47.06	39	57.35
Employment	9	26.47	12	35.29	21	30.88
Businessperson/trade	2	5.88	6	17.65	8	11.76
Income (US Dollar)	Mean ± SD = 3163.86 ± 2884.31		Mean ± SD = 2203.36 ± 2567.28		Mean ± SD = 2683.61 ± 2752.80	
<8915	32	94.12	32	94.12	64	94.12
>8915	2	5.58	2	5.88	4	5.88
Income sufficiency						
Income less than expenses	19	55.88	19	55.88	38	55.88
Income sufficient to cover expenses	12	35.29	13	38.24	25	36.76
Income more than expenses	3	8.82	2	5.88	5	7.35
Smoking history						
Never smoked	25	73.53	25	73.53	50	73.53
Currently smoking	6	17.65	7	20.59	13	19.12
Quit smoking	3	8.82	2	5.88	5	7.35
Alcohol drinking history						
Never drank alcohol	26	76.47	21	61.76	47	69.12
Currently drinking	6	17.65	11	32.35	17	25.00
Quit drinking	2	5.88	2	5.88	4	5.88
Number of people living in the family						
<4	23	67.65	22	64.71	45	66.18
>4	11	32.35	12	35.29	23	33.82
Exercise per week (day)						
<3	23	67.65	16	47.06	39	57.35
3–5	7	20.59	7	20.59	14	20.59
>5	4	11.76	11	32.35	15	22.06

The results of comparing the average scores of health behaviors in the experimental group showed that, after the experiment, the average scores were higher than before the experiment in the physical ($t = -4.48$, $p < 0.001$), mental ($t = -32.75$, $p < 0.001$), and social aspects ($t = -7.27$, $p < 0.001$). Additionally, the average score of the knowledge scores for promoting physical, mental, and social health in the experimental group was higher after the experiment ($t = -8.10$, $p < 0.001$), as shown in Table 2.

The results of comparing the average scores of physical health, mental health, social health, and knowledge on health-promoting behaviors at baseline in both the comparison and experimental groups showed no significant differences. However, after the experiment, the average scores in the physical ($t = -2.81$, $p = 0.01$) and mental ($t = -10.30$, $p < 0.001$) health aspects were significantly higher than before the experiment, except for the social aspect ($t = 0.07$, $p = 0.94$). Additionally, the average knowledge scores for promoting physical, mental, and social health in the experimental group were higher after the experiment ($t = -4.53$, $p < 0.001$), as shown in Table 3.

Table 2. Results of comparing the mean scores of health behaviors between the experimental and comparison groups and between baseline and after the experiment in each group.

Variables	Baseline		After Experiment		*t*	*p*-Value
	Mean ± SD	Interpretation	Mean ± SD	Interpretation		
Experimental group						
- Physical health behaviors	56.41 ± 8.25	Moderate	62.29 ± 4.67	Moderate	−4.48	<0.001
- Mental health behaviors	34.59 ± 5.49	Moderate	50.68 ± 4.37	High	−32.75	<0.001
- Social health behaviors	28.91 ± 5.58	Moderate	33.00 ± 3.73	Moderate	−7.27	<0.001
- Knowledge on health-promoting behaviors in physical, mental, and social health	10.59 ± 3.71	Moderate	15.94 ± 2.01	High	−8.10	<0.001
Comparison group						
- Physical health behaviors	58.44 ± 8.90	Moderate	58.56 ± 6.17	Moderate	−0.11	0.91
- Mental health behaviors	36.74 ± 6.56	Moderate	38.03 ± 5.67	Moderate	−2.42	0.02
- Social health behaviors	28.65 ± 5.66	Moderate	33.09 ± 5.93	Moderate	−6.62	<0.001
- Knowledge on health-promoting behaviors in physical, mental, and social health	10.76 ± 3.14	Moderate	13.47 ± 2.47	High	−6.93	<0.001

Table 3. Results of comparing the mean scores of health behaviors between the experimental and comparison groups' baseline and after the experiment.

Variables	Baseline				After Experimental			
	Comparison Group	Experimental Group	*t*	*p*-Value	Comparison Group	Experimental Group	*t*	*p*-Value
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
Physical health	58.44 ± 8.90	56.41 ± 8.25	0.98	0.33	58.56 ± 6.17	62.29 ± 4.67	−2.81	0.01
Mental health	36.74 ± 6.56	34.59 ± 5.50	1.46	0.15	38.03 ± 5.67	50.68 ± 4.37	−10.30	<0.001
Social health	28.65 ± 5.66	28.91 ± 5.58	−0.19	0.85	33.09 ± 5.93	33.00 ± 3.73	0.07	0.94
Knowledge on health-promoting behaviors in physical, mental, and social health	10.76 ± 3.14	10.59 ± 3.71	0.21	0.83	13.47 ± 2.47		−4.53	<0.001

6. Discussion

This study examined the effects of a health promotion program on knowledge, physical health, mental health, and social health behaviors in individuals at risk for CRC. The findings revealed that the experimental group exhibited higher mean scores in all aspects of health behavior compared to their pre-experiment scores and comparison group. This improvement can be attributed to the health promotion model designed to prevent CRC, which the experimental group received. The program emphasized the importance of changing physical, mental, and social health behaviors, including diet, exercise, relaxation, mental development, and social interactions. These components are essential life skills that facilitate adaptation to changes, making the health promotion model engaging and effective for participants. Consequently, the experimental group showed a significant increase in knowledge and understanding of health behavior changes following the intervention.

The findings from the application of the health promotion model to prevent CRC demonstrated that the experimental group achieved higher mean scores in physical, mental, and social health behaviors, as well as in knowledge about health promotion, both before and after the intervention. These scores were significantly higher than those of the comparison group. This outcome aligns with a prior study in Thailand [35], which found that participants who received a health belief promotion program exhibited significantly higher self-care behavior scores for preventing CRC compared to their pre-intervention scores. Furthermore, these participants had higher self-care behavior scores than those in the usual

care group ($p < 0.05$). Therefore, the development of a health belief model is beneficial in promoting CRC prevention behaviors and can be effectively applied to broader disease prevention efforts to enhance public health [36]. This is consistent with the findings of a prior study, which identified several risk factors for CRC, including the consumption of pork and beef, high-fat foods, alcohol consumption, smoking, lack of exercise, and a BMI exceeding the standard [37]. The findings of this study are also consistent with prior studies conducted in low- and middle-income countries [38–41], which found that health education programs regarding screening intervention among those at risk of CRC were associated with the reporting of CRC cases and screening, cost-effective screening methods, and knowledge about CRC and screening among individuals in low-and middle-income countries. Thus, knowledge significantly influences health promotion behaviors aimed at preventing CRC [27,42]. It serves as a crucial factor in cognition and decision making, enabling individuals to recognize the importance of health, perceive the benefits, seek information, and adopt effective methods for health promotion and the practice of health-enhancing behaviors [25,26,29,30,43].

Social health plays a crucial role in promoting health and preventing CRC. Social health encompasses the relationships and interactions between individuals at risk for CRC, facilitating information exchange, emotional support, social support, financial assistance, and support for returning to work. Healthy interpersonal relationships within personal, professional, and social environments provide essential support for individuals at risk for CRC, enhancing their work satisfaction and overall well-being. This is corroborated by a prior study [44], which found that participants who received high levels of support from family, neighbors, and medical and public health personnel exhibited better health promotion behaviors. Moreover, our research aligns with prior studies in Thailand [26,45], which highlighted that high-level healthcare behavior is facilitated by support and health promotion activities within the community. Factors that positively influence healthcare behavior include receiving healthcare information from various media sources and obtaining advice and support from different individuals, thereby increasing the likelihood of effective treatment and prevention. Adopting healthy habits can significantly reduce the risk of CRC. These habits include consuming fiber-rich foods, engaging in regular exercise, and reducing alcohol consumption and smoking [31,46]. Additionally, preventive measures such as regular screenings, annual checkups, and maintaining health-promoting behaviors are vital in lowering the risk of CRC [47].

In this study, the health promotion program likely had a significant impact on social health behaviors by emphasizing the importance of community support, family involvement, and social connections in maintaining overall health. Activities such as group discussions, community engagement exercises, and family oriented health promotion practices may have enhanced participants' social interactions, leading to improved social health behaviors. By fostering a supportive environment where participants could share experiences and learn from each other, the intervention may have helped them feel more connected and supported, which is crucial for sustained behavior change. For mental behaviors, this intervention likely improved mental health behaviors by introducing stress management techniques and promoting mental well-being as integral components of overall health. The emphasis on mental health education, combined with practical exercises, likely contributed to participants adopting healthier mental health practices, such as regular relaxation routines and seeking support when needed. Additionally, the intervention's focus on physical health education, including proper nutrition, regular exercise, and the importance of preventive screenings, likely contributed to the observed improvements in physical health behaviors. The practical training in healthy eating, exercise routines, and physical activity skills may have empowered participants to make healthier choices in their daily lives. Additionally, the intervention's emphasis on the connection between physical health and disease prevention, particularly CRC, likely motivated participants to adopt and maintain these behaviors.

The present study has several limitations. Firstly, the sample size was relatively small and homogenous, limiting the generalizability of the findings to a broader population. Participants were individuals at risk of colorectal cancer from a single province in Thailand, which may limit the generalizability of our findings to other populations in different contexts, such as urban communities. Additionally, the study included only participants aged 40–70 years, which may restrict the applicability of the findings to younger or older age groups. Future studies should aim to include larger, more diverse cohorts to enhance the representativeness of the results. Secondly, the study focused on short-term outcomes of an 8-week health education intervention of the health promotion program on participants' knowledge, physical health, mental health, and social health behaviors, highlighting the need for a more detailed investigation into the relationships between demographic data, health behaviors, and clinical outcomes. Longitudinal studies with extended follow-up periods are necessary to evaluate the sustainability of the program's benefits over time. Thirdly, data collection relied heavily on self-reported measures, which are susceptible to social desirability bias and recall bias. Participants might have overestimated their adherence to health behaviors or their improvements. Future research should incorporate objective measures, such as physical activity trackers, dietary logs verified by nutritionists, and clinical health assessments, to complement self-reported data. One of the key components of this study was the development of a research questionnaire aimed at assessing knowledge, health behaviors, and perceptions related to CRC prevention among high-risk groups in Thailand. The questionnaire was developed based on a comprehensive review of the existing literature and guided by the HBM. While the questionnaire provided valuable insights into health behaviors and perceptions related to CRC prevention, the limitations mean there is a need for caution when interpreting the findings. Future research should consider expanding the validation process, integrating multiple theoretical frameworks, and addressing the potential biases inherent in self-reported data to enhance the reliability and applicability of the results. Additionally, the study did not control for several potential confounding variables, including socioeconomic status, baseline health conditions, and access to healthcare resources. These factors could have significantly influenced the outcomes. Subsequent research should employ more rigorous study designs, such as randomized controlled trials, to better isolate the effects of the intervention and control for these confounders. Moreover, the intervention's components were not individually evaluated for their specific contributions to the overall effect. Future research should consider using a factorial design to disentangle the impact of each component of the health promotion program (nutrition, exercise, stress management) to identify which elements are most effective. Lastly, cultural factors and individual differences in health literacy were not adequately addressed. Future studies should tailor health promotion interventions to be culturally sensitive and consider varying levels of health literacy to ensure the program's accessibility and effectiveness for all participants. In summary, while this study highlights the positive impact of a health promotion program on individuals at risk for colon cancer, future research should focus on addressing these limitations by employing larger and more diverse samples, incorporating longer follow-up periods, utilizing objective measures, controlling for confounding variables, evaluating individual components of the intervention, and ensuring cultural sensitivity and health literacy considerations.

7. Conclusions

This study demonstrates the effectiveness of a culturally tailored health promotion model designed to prevent CRC among high-risk populations in Thailand. The results showed significant improvements in physical, mental, and social health behaviors, as well as increased knowledge about CRC prevention in the experimental group compared to the control group. These findings underscore the potential of targeted health education interventions to enhance health behaviors and knowledge in at-risk populations, providing evidence that such models can be effectively implemented in low- and middle-income countries. This study contributes to the existing body of knowledge by applying the HBM

in a novel context, highlighting how health beliefs influence preventive behaviors related to CRC in a Thai population. Our research advances the theoretical understanding of health behavior change by demonstrating that incorporating culturally specific beliefs and practices can enhance the effectiveness of health promotion programs. This refined application of the HBM provides a valuable framework for future studies aiming to develop targeted interventions for diverse populations in similar settings. Practically, our findings suggest that health personnel should advocate for regular CRC screenings and the implementation of comprehensive health promotion programs that address physical, mental, and social health aspects for at-risk groups. This study highlights the necessity for long-term health promotion models to achieve sustained improvements in health outcomes and reduce CRC incidence. By demonstrating the effectiveness of these targeted interventions, our research informs public health policy and practice, suggesting that similar approaches could be adapted and scaled to other low- and middle-income countries facing comparable public health challenges. Despite this study's limitations, it provides critical insights into the role of health education programs in improving health outcomes for individuals at risk of CRC. Future research should continue to refine these models, explore their scalability, and assess their long-term impact to develop effective public health strategies that can be widely implemented to reduce CRC incidence and enhance overall population health. The findings of this study, therefore, make a meaningful contribution to both academic research and practical applications in the field of public health.

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